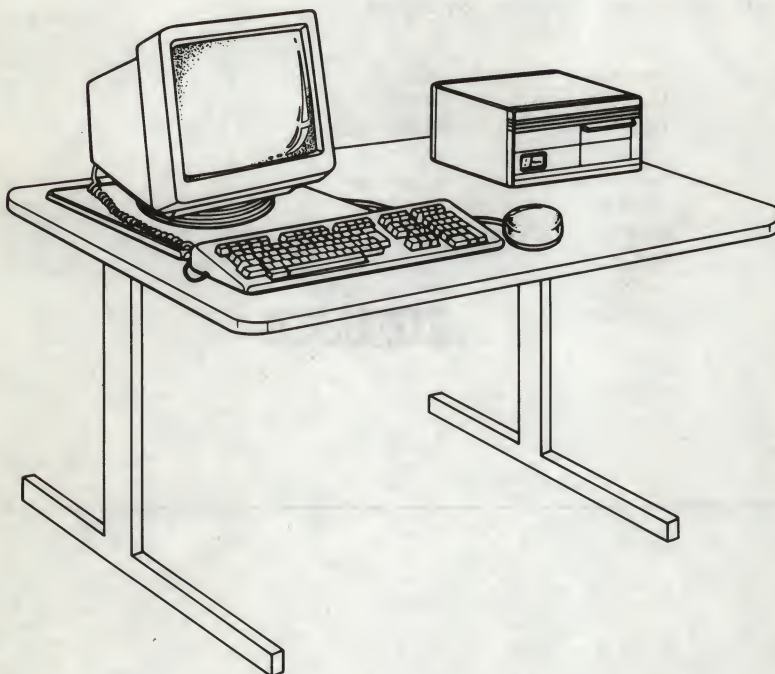


Workstations and MicroVAX 2000 Network Guide

Order Number EK-NETAB-UG-002



**digital equipment corporation
maynard, massachusetts**

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DEUNA	RSX	VT
DIBOL	RT	Work Processor
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Contents

Preface

vii

Chapter 1 Overview

What Makes a Network?	1-1
Standard Ethernet	1-1
ThinWire Ethernet	1-1
Unshielded Twisted-Pair Ethernet	1-2
DECnet	1-3
Networking Capabilities of ULTRIX	1-3
Local Area VAXclusters	1-4

Chapter 2 Setting Up the Network

Standard Ethernet	2-1
Basic ThinWire Components	2-2
ThinWire Ethernet Cable	2-3
Connectors and Terminators	2-5
Additional Equipment	2-6
DIGITAL ThinWire Ethernet Multiport Repeater (DEMPR)	2-6
DIGITAL ThinWire Ethernet Station Adapter (DESTA)	2-7
DEBETs — The Ethernet Bridge	2-8
ThinWire Configurations	2-8
DECconnect Approach	2-9
Daisy-chain Approach	2-10
Combined Daisy-chain and DECconnect Approach	2-10
Single Segment Configuration	2-11
Multisegment ThinWire Configuration	2-13
ThinWire Ethernet Rules	2-14
Configurations Symbols	2-14

Single Segment ThinWire Ethernet	2-15
Stand-alone DEMPR	2-17
Combined Standard/ThinWire Ethernet LAN	2-18
Stand-alone Cascading DEMPRs	2-19
Stand-alone DELNI with DEMPRs	2-20
Local Bridge	2-21
Disconnecting Stations from ThinWire Ethernet	2-22
Local Area VAXcluster Configuration	2-23

Chapter 3 Installing ThinWire Hardware

Before You Start	3-1
Determining Your Needs	3-1
ThinWire Ethernet Cable	3-1
Connectors	3-1
Barrel Connectors and T-Connectors	3-2
DESTA and Transceiver Cable	3-2
Terminators	3-2
DEMPR	3-2
Estimating Your Needs	3-2
Planning the ThinWire Segment	3-3
Setting the Switch for ThinWire Ethernet	3-4
Connecting to a ThinWire Ethernet Segment	3-4
Connecting VAXstation 2000, MicroVAX 2000, or VAXmate	3-5
Connecting a Station with a Transceiver Cable	3-8
Connecting to an Existing ThinWire Network	3-12
How to Install a DEMPR	3-12
Stand-alone DEMPR	3-13
Connecting the DEMPR to Standard Ethernet	3-16
How to Lengthen a ThinWire Segment	3-16
How to Verify Network Installation for a VAXstation 2000 or MicroVAX 2000	3-17
How to Verify Installation for a VAXmate	3-18
Troubleshooting the ThinWire Segment	3-18
Troubleshooting the DEMPR	3-19
Troubleshooting the DESTA	3-19

Troubleshooting Network Software	3-19
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Appendix A Associated Documents

Glossary

Index

Figures

2-1	Setting the Switch for Standard Ethernet	2-1
2-2	Connecting the Intermediary Cable	2-2
2-3	ThinWire Ethernet Cable	2-4
2-4	Connectors	2-5
2-5	DIGITAL ThinWire Ethernet Multiport Repeater (DEMPR)	2-6
2-6	DIGITAL ThinWire Ethernet Station Adapter (DESTA)	2-7
2-7	Symbols for Cables	2-8
2-8	DECconnect Method of Wiring	2-9
2-9	Single Segment Configuration	2-11
2-10	Connecting ThinWire Ethernet to Standard Ethernet	2-12
2-11	Multisegment ThinWire Configuration	2-13
2-12	Symbols for Configurations	2-14
2-13	Single Segment ThinWire Configuration	2-16
2-14	Stand-alone DEMPR with ThinWire Cables	2-17
2-15	DEMPR on Standard Ethernet	2-18
2-16	Stand-alone Cascading DEMPRs	2-19
2-17	Stand-alone DELNI with DEMPRs	2-20
2-18	Local Bridge	2-21
2-19	Disconnecting a Station from ThinWire Ethernet	2-22
2-20	Local Area VAXcluster	2-24
3-1	Setting the Switch for ThinWire Ethernet	3-4
3-2	Connecting the T-connector to ThinWire	3-5
3-3	Connecting a Terminator to the T-connector	3-6
3-4	Adding a Segment to the T-connector	3-6

3-5	Connecting the T-connector to VAXstation 2000	3-7
3-6	Connecting the T-connector to ThinWire	3-8
3-7	Connecting a Terminator to the T-connector	3-9
3-8	Adding a Segment to the T-connector	3-9
3-9	Attaching the T-connector to the DESTA	3-10
3-10	Attaching the Transceiver Cable to the DESTA	3-11
3-11	ThinWire Cables Connected to the DEMPR	3-13
3-12	Attaching a Terminator to a ThinWire Segment	3-14
3-13	Terminator Connected to the DEMPR	3-15
3-14	Connecting Two ThinWire Sections	3-16

Tables

2-1	Ordering Information for ThinWire Ethernet Cables	2-4
3-1	Form to Order ThinWire Equipment	3-3

Preface

This manual describes how to configure and install some simple ThinWire Ethernet networks for VAXstation 2000, MicroVAX 2000, or VAXmate systems. It does not describe all possible configurations, but outlines the rules to follow when configuring your network with ThinWire Ethernet.

Recommended Reading Path

1. *VAXstation 2000 Hardware Installation Guide*, *MicroVAX 2000 Hardware Installation Guide*, or *VAXmate System Handbook*. You should install your VAXstation 2000, or VAXmate system before installing ThinWire Ethernet.
2. *Workstations and MicroVAX 2000 Network Guide*, Chapter 2. This chapter tells you how to configure your network.
3. *Workstations and MicroVAX 2000 Network Guide*, Chapter 3. This chapter describes how to install ThinWire Ethernet hardware on your system.

A glossary at the end of the book explains technical terms used in this book.

Conventions

The following notices appear throughout this guide:

- **Notes** — Contain general or supplemental information about a topic.
- **Caution** — Contain information to prevent disruption of the network.

Convention	Meaning
Bold	Notes, cautions, and warnings are bolded.
<i>Italics</i>	Terms defined in the glossary are italicized the first time the word appears in the text.

Document Structure

This manual consists of three chapters and an appendix.

- Chapter 1 gives an overview of ThinWire Ethernet, defines networks, and describes DECnet, ULTRIX networks, and VAXclusters.
- Chapter 2 describes the basic components you will need, some simple configurations, and the rules for connecting to ThinWire Ethernet.
- Chapter 3 describes how to determine your needs and how to install and troubleshoot a ThinWire Ethernet network.
- The appendix lists associated documents that might be helpful in planning your network.

Chapter 1

Overview

Networks are useful to people who need to work together and share information but still want the attractive features of their own workstation. People working cooperatively on a project may need to communicate and exchange information, share common data bases, share files, or use a mail system, and yet keep their workstation independent. Networks also allow you to share devices, such as laser printers or line printers.

What Makes a Network?

A network is a group of computers connected by communications lines to share information and resources. You need special network hardware and software to connect your network. *DECnet* software enables computers to form a network.

Standard Ethernet

Ethernet is the DIGITAL local area network. *Ethernet* networks provide rapid access to data in remote locations, and the high data rate supported by DIGITAL's *DECnet* software makes file transfers practical.

In baseband Ethernet (Standard or *ThinWire*), a single network cable replaces the numerous interconnecting cables in traditional data networks. Standard Ethernet cable is recommended for communications between floors and buildings. *ThinWire* cable is recommended for communications between workstations, personal computers, and low-end systems in local work areas on a floor.

ThinWire Ethernet

ThinWire is a networking cabling system and set of products that deliver 10 megabits-per-second Ethernet to the desk, work area, and local area systems for connection of personal computers, workstations, network servers, and low-end computing devices. All DIGITAL Ethernet products can connect to *ThinWire* offering an alternative wiring approach for low-end, mid-range,

and high-end systems and Ethernet servers without any change in network performance.

ThinWire Ethernet is used in any size environment. It is ideal for a small stand-alone network in which personal computer and workstation users share resources, such as printers and storage devices. ThinWire works well as a small- to medium-sized stand-alone *local area network (LAN)* in a small business or in a department of a larger organization where personal computer and workstation users need local resource sharing and more powerful computing resources. A LAN is a high-speed communications network that covers a limited geographical area, such as a section of a building, an entire building, or a cluster of buildings.

Unshielded Twisted-Pair Ethernet

The *Unshielded Twisted-Pair* Ethernet Adapter delivers 10 megabits-per-second Ethernet performance to the desktop, work area, and local system over unshielded twisted-pair building cable.

Unshielded twisted-pair adapters connect a single device,

- DESTA with MicroVAX attached
- VAXmate
- VAXstation 2000
- Personal computer with DEPCA, DELUA, or DELQA Ethernet controllers

to the Ethernet network by means of the DIGITAL ThinWire Ethernet Multiport *Repeater (DEMPR)*. Small stand-alone local area networks, where a personal computer and workstation user share limited local resources (printers, storage devices), can be connected as a subnetwork to large local area and wide area networks.

Functionally, the office adapter and wiring closet/*SER* adapter work as a pair to match the 50-ohm impedance on a ThinWire Ethernet coaxial cable to the impedance on an unshielded twisted-pair cable. Thus, unshielded twisted-pair building wiring can be used, in addition to ThinWire cable, to run Ethernet to the desktop.

Unshielded Twisted-Pair Ethernet Adapters are compatible with the ThinWire Ethernet products and IEEE 802.3 specifications for "Medium Attachment Unit and Baseband Medium Specifications for Type 10 Base 2."

The maximum length of 24 AWG unshielded twisted-pair cable that can be used between the office adapter and the wiring closet adapter is 50 to 70 meters (164 to 230 feet).

DECnet

DECnet, a software product that enables many DIGITAL computer systems to form a network, is derived from a well-defined network architecture called the DIGITAL Network Architecture (DNA). DNA, similar to the standard International Standards Organization (ISO) communication architecture, is the logical structure that provides a model for DECnet implementations. DECnet provides:

- Task-to-task communications — allows programs executing in different systems to exchange information.
- File transfer — supports the copying of files among different systems.
- Remote file access — allows the user to read, write, delete, or modify files on another system.
- Remote command file submission and execution — allows one computer system to direct another system to execute commands and/or perform tasks.
- Down-line loading — allows programs developed on a system with appropriate peripherals and resources to be sent to another system, such as a small, memory-only system, for execution.
- The network virtual terminal — gives a user connection to a remote system; the terminal operates as if it were connected to the remote system.
- Network management — provides for monitoring and controlling network operation in a distributed environment.

Networking Capabilities of ULTRIX

TCP/IP networking protocols are standard with the *ULTRIX-32* software. They are an integral part of the operating system and facilitate interaction with Internet networks. Support includes file transfer, remote execution, remote login, and resource-sharing capabilities with other systems running the TCP/IP protocols.

DECnet-ULTRIX provides an Ethernet-based communication link between VMS and ULTRIX operating systems. ULTRIX bridges both environments by supporting the coexistence of the DECnet and TCP/IP protocols. DECnet

and TCP/IP can run simultaneously and share the same system resources, such as the *DEUNA* and *DEQNA* Ethernet interfaces. This feature allows a DECnet-ULTRIX system to act as an informal gateway between DECnet networks and Internet networks. DECnet-ULTRIX allows ULTRIX to interact with other DIGITAL and non-DIGITAL operating systems, using DECnet products such as DECnet-RSX, DECnet-VAX, DECnet-DOS.

Local Area VAXclusters

The computer industry today provides individuals or small work groups in organizations with their own personal computer systems or workstations, solving the computing availability problem but creating a new set of problems — managing large numbers of geographically dispersed personal workstations. Another problem for users is that they have inherited system management responsibilities and need to have more knowledge of the operating system to perform system management tasks.

The *Local Area VAXcluster* using *ThinWire* or *standard Ethernet* as the interconnect allows DIGITAL's low-end VAX/MicroVAX products to be grouped in similar VMS worksystems, removing the problems of system management on a per node basis and elevates it to a single system management domain. Except for the interconnect-dependent driver software, the same VAXcluster software is used on both CI-based clusters and ThinWire or standard Ethernet-based clusters.

The Local Area VAXcluster system also solves the problems of inadequate disk space and data sharing among members of a group or team. VAXclusters provide distributed processing capabilities to allow load-sharing batch and print processing across member nodes or to target a node, reducing the amount of wasted or underutilized computes.

One other problem is MicroVMS has to be installed on every MicroVAX or VAXstation. In a Local Area VAXcluster, the system requires no local software installation and can be plugged into a suitable ThinWire or standard Ethernet connection and be remotely booted, removing the need for local software installation.

Special software allows membership in a Local Area VAXcluster. This software provides flexibility by allowing many Local Area VAXclusters to share the same Ethernet or ThinWire Ethernet *segment* and to allow nodes to logically move from one cluster to another.

Chapter 2

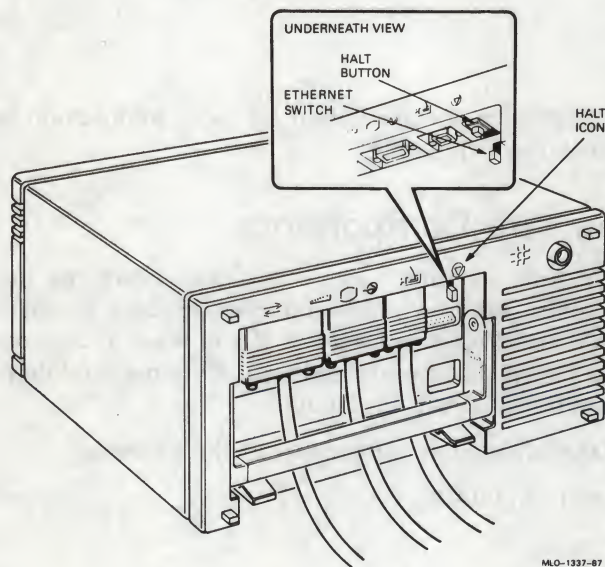
Setting Up the Network

This chapter describes the basic components you will need, some simple topologies, and the rules for connecting a system to ThinWire Ethernet. This chapter also describes how to set up your system to connect to standard Ethernet.

Standard Ethernet

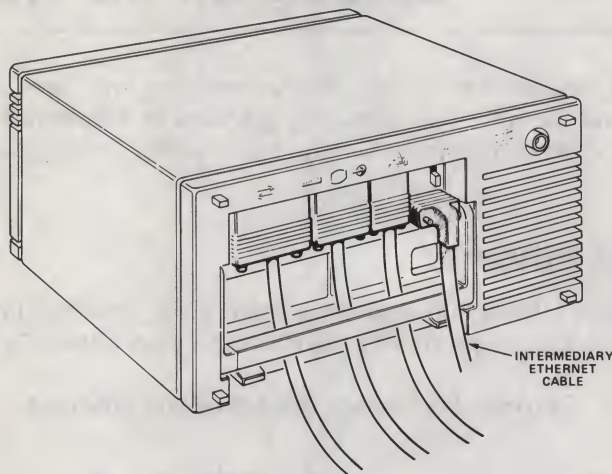
To use standard Ethernet on your VAXstation 2000, move the Ethernet switch on the back of the system unit to the down position (Figure 2-1).

Figure 2-1: Setting the Switch for Standard Ethernet



Locate the Ethernet intermediary cable (part no. 1701860-01) that comes with your system unit. Connect it to the back of the system unit as shown in Figure 2-2.

Figure 2-2: Connecting the Intermediary Cable



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Refer to the *DECconnect* documentation for more information on connecting your system to standard Ethernet.

Basic ThinWire Components

The Ethernet Module contains a *transceiver* that allows you to connect your system to ThinWire Ethernet. The Ethernet Module is preinstalled in all VAXstation 2000 and VAXmate systems. If you want to connect a MicroVAX 2000 system to ThinWire Ethernet, order the Ethernet Module preinstalled or contact field service to install the module.

The Ethernet Module equipment consists of the following:

- One Ethernet Module
- Two *terminators*
- One *T-connector*

Contact your DIGITAL representative to order ThinWire cable lengths with connectors at each end.

If you prefer, you can purchase ThinWire Ethernet cable on a spool and cut the cable to your needs. See the *VAXstation 2000/MicroVAX 2000 Maintenance Guide* for information on cutting and crimping ThinWire Ethernet cable.

Before reading about configurations, you need to know the following terms:

- *Station* — A single addressable device on a Local Area Network; for example, a VAXstation 2000, MicroVAX 2000, or VAXmate.
- *Section* — A single continuous piece of *coaxial cable*.
- *Segment* — Any number of ThinWire sections joined by *barrel connectors* or T-connectors to form a single, continuous cable.

ThinWire Ethernet Cable

ThinWire Ethernet cable has a jacket of either *polyvinyl chloride (PVC)* or *Teflon*. Either PVC or *Teflon cable* can be used in an open office area. However, in the United States, Teflon may be required for areas classified by the Underwriter's Laboratory (UL) as environmental air spaces, such as in air-conditioning ducts or air *plenum*. An air plenum is a compartment or chamber to which one or more compartments are connected in a building ventilation system and is only used for carrying environmental air. Check your local building codes for more information.

ThinWire Ethernet cable delivers 10 megabits-per-second performance and full Ethernet functionality.

The maximum length of a segment is 185 m (606 ft).

ThinWire Ethernet products adhere to the IEEE standard 802.3. ThinWire Ethernet products are compatible with products that conform to this international standard. ThinWire Ethernet cable is:

- Flexible
- Fully compatible with standard Ethernet
- Inexpensive
- High performance

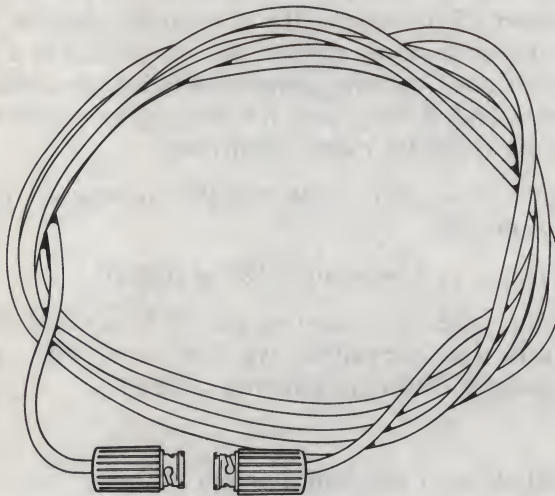
You can order ThinWire Ethernet cables in the following cable lengths:

Table 2-1: Ordering Information for ThinWire Ethernet Cables

Order No.	Description
BC16M-06	ThinWire Cable, PVC, 6'
BC16M-15	ThinWire Cable, PVC, 15'
BC16M-30	ThinWire Cable, PVC, 30'
H8243-A	ThinWire Cable, PVC, 1000' spool
H8244-A	ThinWire Cable, Teflon, 1000' spool

Figure 2-3 shows the ThinWire Ethernet cable.

Figure 2-3: ThinWire Ethernet Cable



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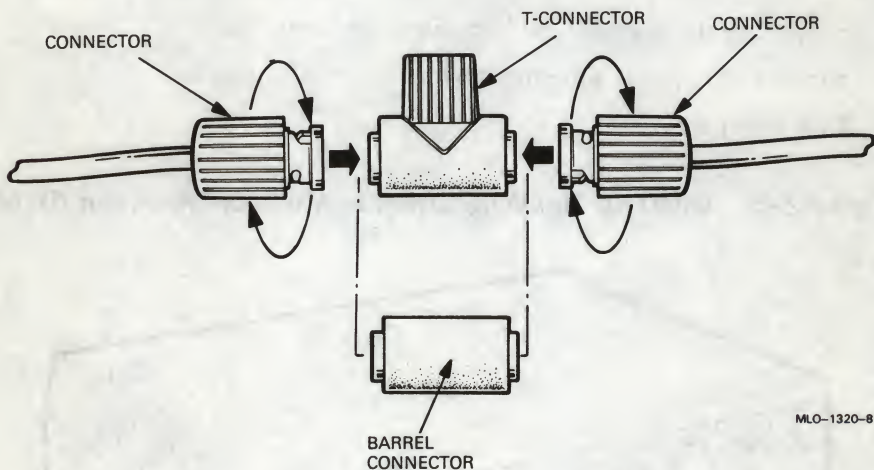
Connectors and Terminators

The ThinWire connectors and terminators you need to configure your network follow:

- T-connector (H8223) — A 3-way connector that joins two ThinWire Ethernet cable sections. The third opening attaches to a VAXstation 2000, MicroVAX 2000, or a VAXmate system.
- Terminator (H8225) — A connector at the end of a ThinWire segment that provides the 50-ohm termination resistance needed for the cable. If the ThinWire cable connects to a DIGITAL ThinWire Ethernet Multiport Repeater (DEMPR), then a terminator is only needed at one end of the cable.
- Barrel connector (H8224) — A recessed connector that connects two ThinWire Ethernet cable sections.

Figure 2-4 shows the connectors you need to connect to ThinWire Ethernet.

Figure 2-4: Connectors



Additional Equipment

Use the following equipment for additional configurations:

- DIGITAL ThinWire Ethernet *Multiport Repeater* (DEMPR-AA)
- DIGITAL ThinWire Ethernet *Station Adapter* (DESTA-AA)
- Ethernet *Bridges* (DEBET-AA)

DIGITAL ThinWire Ethernet Multiport Repeater (DEMPR)

A DEMPR is a repeater, a device used to extend the length, *topology*, or interconnection of the physical network medium beyond the limits imposed by a single segment.

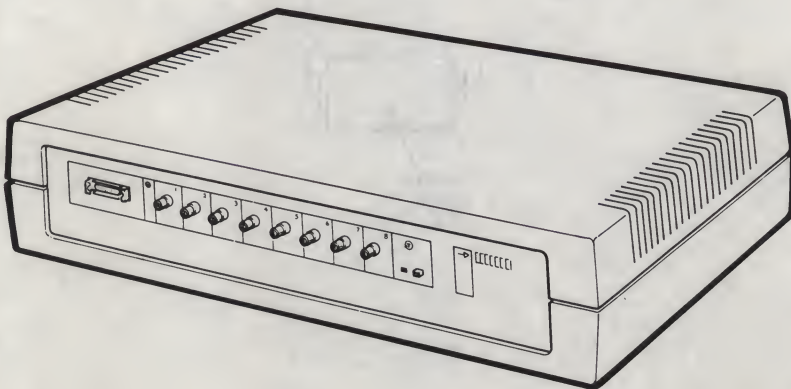
You can connect up to eight ThinWire Ethernet segments to a single DEMPR to form a single Local Area Network. Or, you can connect a ThinWire LAN to standard Ethernet through the DEMPR. Each segment can have 29 *stations* (the 30th position is taken by the DEMPR) for a total of up to 232 stations.

Figure 2-5 shows the DEMPR.

The DEMPR offers:

- Support of up to eight ThinWire Ethernet connections
- Support of multiple Ethernet devices for each connection
- Easy installation

Figure 2-5: DIGITAL ThinWire Ethernet Multiport Repeater (DEMPR)



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DIGITAL ThinWire Ethernet Station Adapter (DESTA)

The DESTA is an Ethernet/IEEE 802.3 transceiver that connects systems (such as the MicroVAX II, VAXstation II, VAXstation II/GPX, VAX 11/7XX, VAX/8XXX, Professional 300, and PDP-11) to ThinWire Ethernet. (A transceiver is a device that provides a single physical connection between standard Ethernet and Ethernet communication equipment.)

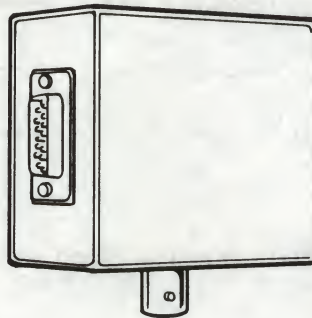
The DESTA has two *ports*: one port connects to the T-connector connected to ThinWire, a second port connects a transceiver cable that leads to a system.

Figure 2-6 shows a DESTA.

The DESTA provides:

- Connection of a system with a transceiver cable to ThinWire Ethernet.
- Attachment to devices connected to Ethernet communication controllers by way of transceiver cables.

Figure 2-6: DIGITAL ThinWire Ethernet Station Adapter (DESTA)



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DEBETs — The Ethernet Bridge

Ethernet bridges (*DEBET*) connect standard Ethernet LANs to each other, thus creating an extended LAN. An extended LAN configuration has the potential to span a much greater area than a single standard Ethernet LAN.




DEBETs provide network traffic control to prevent an extended LAN from being overwhelmed by the combined traffic on each of its standard LANs. DEBETs confine local traffic in a standard Ethernet LAN. Only traffic that is destined for another standard LAN is allowed to cross over the DEBET.

ThinWire Configurations

A ThinWire configuration is an economical way to connect VAXstation 2000s, MicroVAX 2000s, or VAXmates in a network configuration.

Figure 2-7 shows the symbols for cables used in the ThinWire configurations in this section of the book.

Figure 2-7: Symbols for Cables

STANDARD ETHERNET COAXIAL CABLE	
THINWIRE ETHERNET COAXIAL CABLE	
TRANSCIVER CABLE	

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Three ways to design a ThinWire configuration are:

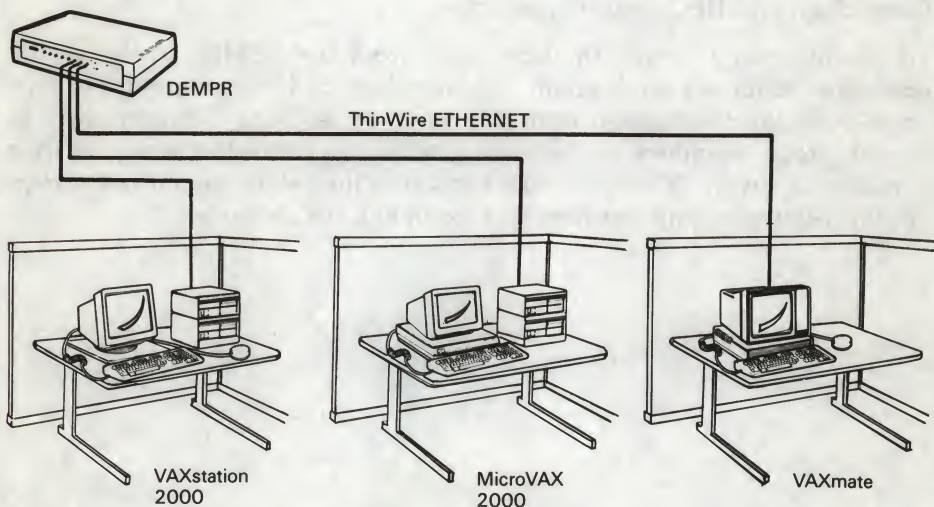
1. DECconnect approach
2. Daisy-chain wiring approach
3. Combined DECconnect and Daisy-chain approach

DECconnect Approach

The DECconnect approach to wiring uses a single ThinWire cable for each machine. This approach is flexible and reliable. It is reliable since no other machines come between your machine and the central equipment room or DEMPR. Consult your DIGITAL representative for more information about DECconnect. The appendix lists the DECconnect documentation.

Figure 2-8 illustrates a single system on each ThinWire segment connected to a DEMPR.

Figure 2-8: DECconnect Method of Wiring



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Daisy-chain Approach

The other approach to ThinWire configurations used in this book is the daisy-chain method of wiring. Several machines are connected to the same ThinWire segment. This segment can function as a stand-alone network or can be connected to a central equipment room.

This approach lowers the cost of wiring, but there is a risk that someone might improperly unplug a system and make the network connections between systems on the same ThinWire segment inoperative.

Combined Daisy-chain and DECconnect Approach

A third way to improve reliability and lower costs would be to combine the Daisy-chain and DECconnect approaches.

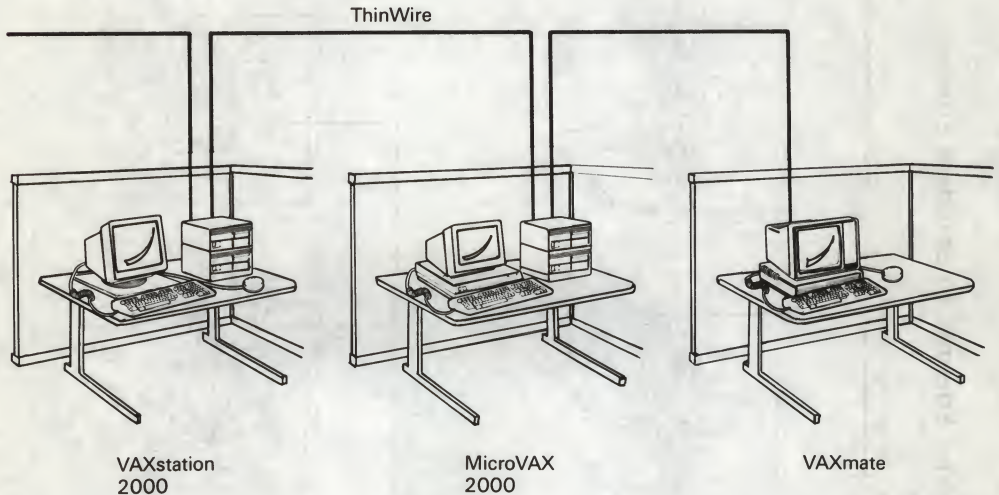
To do this, run a single ThinWire cable from the DEMPR in the central equipment room to a work group. The members of the work group can then daisy-chain their equipment from this wire. By isolating the daisy-chain in a work group, members of the work group can control the wiring of their part of the network. This procedure eliminates the risk of any outside groups improperly unplugging a system and disrupting the network.

Single Segment Configuration

Figure 2-9 illustrates a ThinWire configuration in an office environment where VAXstation 2000, MicroVAX 2000, and VAXmate systems are serially linked to a single segment of ThinWire Ethernet cable in a local area network (LAN).

Chapter 3 describes how to connect systems with ThinWire cable.

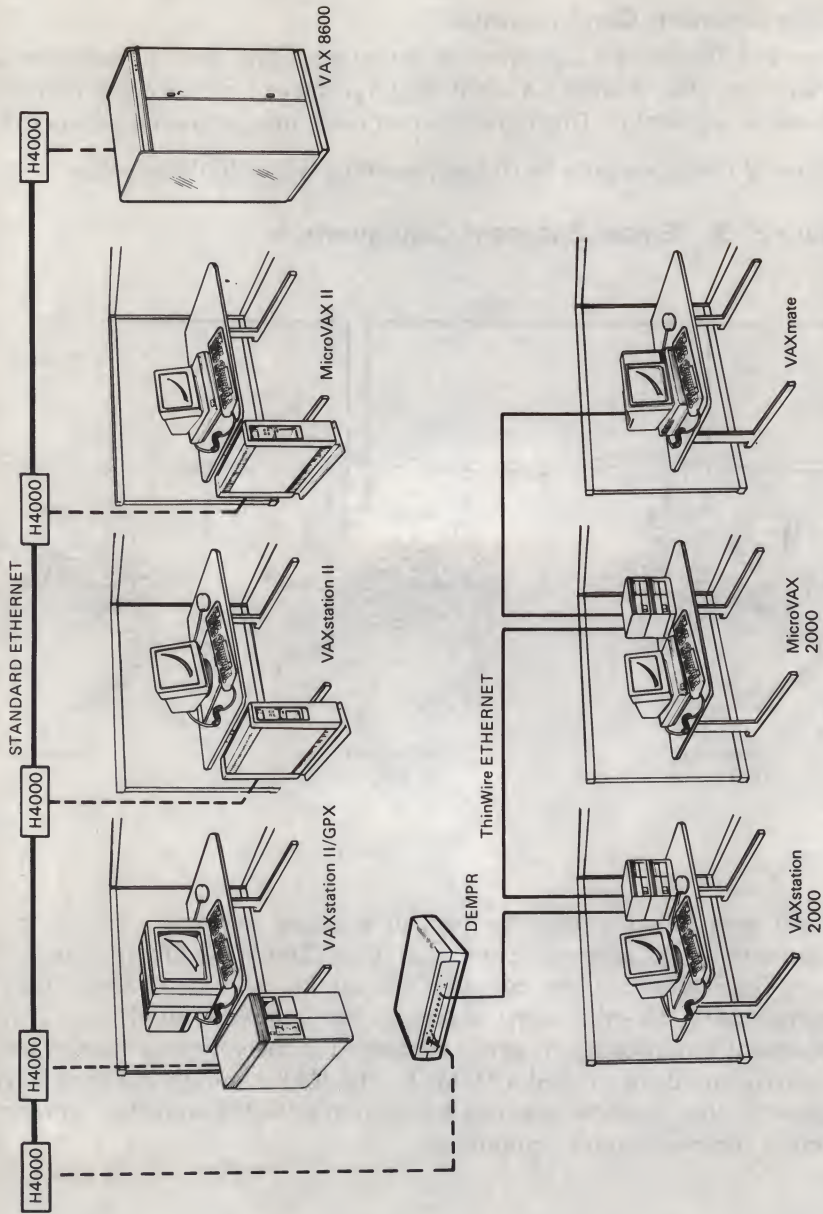
Figure 2-9: Single Segment Configuration



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A local area network may be part of a larger network. For example, a department of a large company that uses ThinWire Ethernet in a LAN, shown in Figure 2-9, to communicate in its own department may also communicate with other departments in the company. In Figure 2-10, the department's local area network is connected to the company's larger network by a hardware device called a DEMPR. The *H4000* shown in Figure 2-10 is a transceiver that provides a single connection between standard Ethernet and Ethernet communication equipment.

Figure 2-10: Connecting ThinWire Ethernet to Standard Ethernet

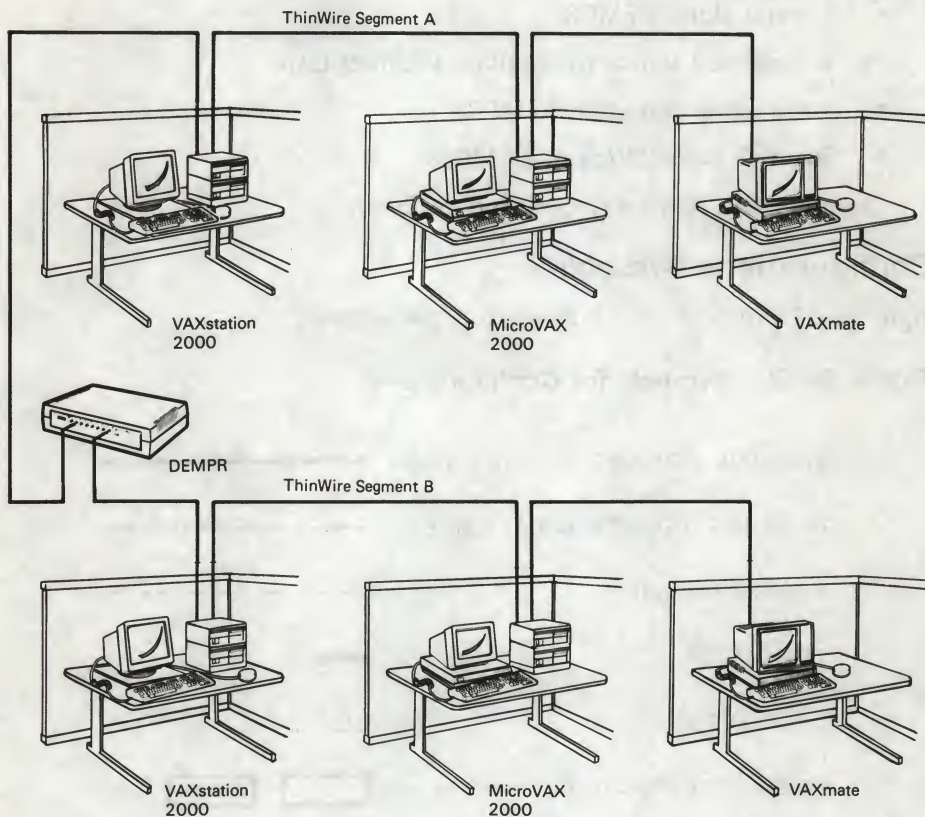


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Multisegment ThinWire Configuration

Figure 2-11 illustrates a multisegment ThinWire configuration that uses the DEMPR to connect several ThinWire segments.

Figure 2-11: Multisegment ThinWire Configuration



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ThinWire Ethernet Rules










This section describes the rules for:

- Setting up:
 - A single segment ThinWire Ethernet LAN
 - A stand-alone DEMPR
 - A combined standard/ThinWire Ethernet LAN
 - Stand-alone cascading DEMPRs
 - Stand-alone *DELNI* with DEMPRs
- Disconnecting stations from ThinWire Ethernet

Configurations Symbols

Figure 2-12 shows the symbols used in this section.

Figure 2-12: Symbols for Configurations

STANDARD ETHERNET COAXIAL CABLE	
THINWIRE ETHERNET COAXIAL CABLE	
TRANSCEIVER CABLE	
TERMINATOR	
T-CONNECTOR	
ETHERNET TRANSCEIVERS	 
STATION	
LOCAL BRIDGE	

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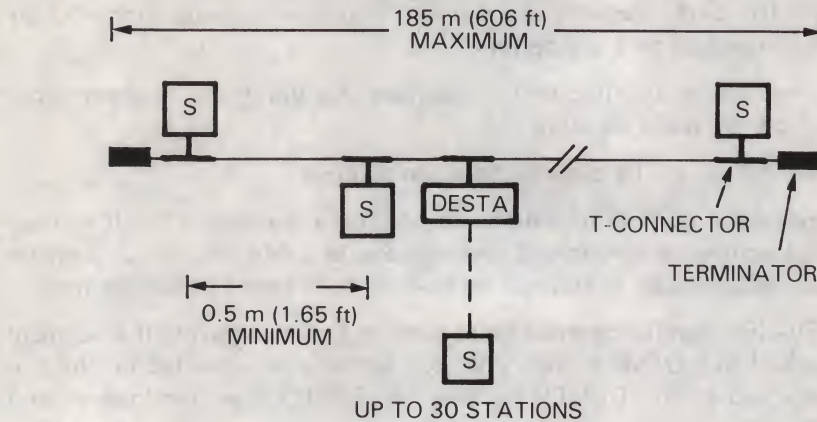
Single Segment ThinWire Ethernet

The following rules for single segment ThinWire Ethernet apply to all ThinWire Ethernet configurations:

- The maximum allowable length of a ThinWire Ethernet segment is 185 m (606 ft). Each segment can consist of smaller sections connected by barrel connectors or T-connectors.
- Stations must be attached to T-connectors. No unrepeated segments can extend off the main segment.
- At least 0.5 m (1.6 ft) must be between stations.
- The maximum number of stations allowed on a segment is 30. If you use a barrel connector to connect two sections of cable, you must decrease the allowed number of stations by one for each barrel connector used.
- One 50-ohm terminator must be at each end of a segment. If a segment is attached to a DEMPR, then only one terminator is needed on the end not attached to the DEMPR because the DEMPR has terminators built into it.
- Only one earth *ground* point is necessary. If the station is attached to a DEMPR, the DEMPR provides this ground point.
- ThinWire Ethernet networks must adhere to the Ethernet 2-repeater rule: no more than two repeaters between any two stations. A repeater provides a means of extending Ethernet networks beyond the limits imposed by a single segment. The DEMPR counts as a single repeater.
- ThinWire Ethernet networks cannot exceed the Ethernet 1024-station limit for each area.
- ThinWire segments must remain in a building or a complex of buildings that shares common structural steel.

Figure 2-13 shows a single segment of ThinWire cable with stations connected.

Figure 2-13: Single Segment ThinWire Configuration



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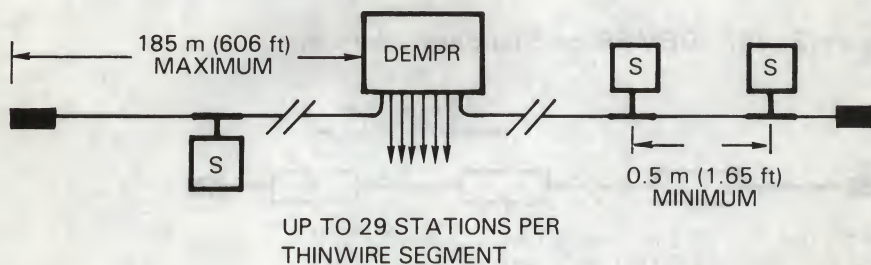
Stand-alone DEMPR

A stand-alone DEMPR is a DEMPR that is not connected to a larger network. Each segment attached to a DEMPR must use the guidelines for single segment ThinWire Ethernet and the following guidelines:

- One to eight ThinWire cables can be attached to a DEMPR.
- Each cable can be up to 185 m (606 ft) long.
- Each cable can have up to 29 stations (the 30th position is taken by the DEMPR).
- Segments connected to the DEMPR must **NOT** be grounded. The DEMPR internally grounds the eight ThinWire segments.

Figure 2-14 shows a stand-alone DEMPR with ThinWire cables.

Figure 2-14: Stand-alone DEMPR with ThinWire Cables



MLO-1330-87

Combined Standard/ThinWire Ethernet LAN

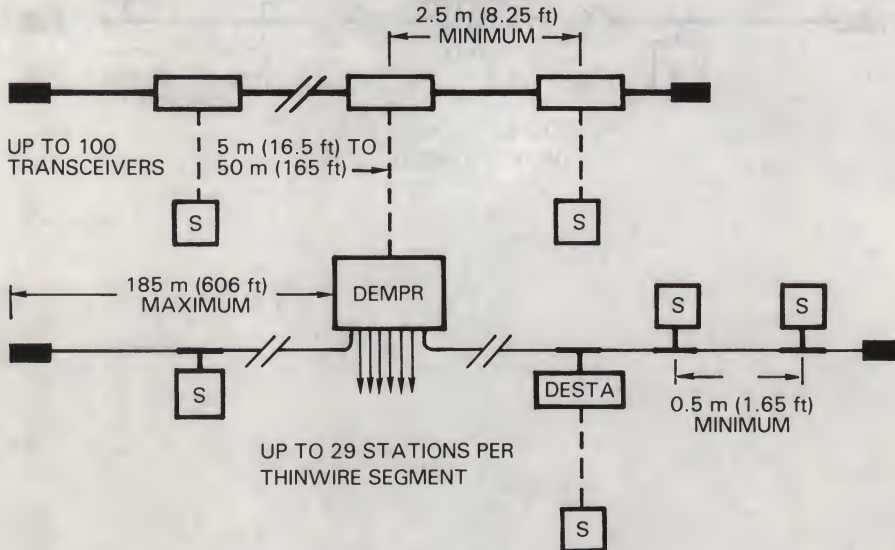
This configuration follows the guidelines for the stand-alone DEMPR. In addition are the following guidelines:

- The DEMPR can attach to a regular Ethernet by a transceiver or a DELNI. A DELNI is a local network interconnect product that provides eight separate network interfaces from a single transceiver tap.
- If you connect a DEMPR to standard Ethernet by a DELNI, you must connect the DELNI to Ethernet by an *H4000-BA*. The H4000-BA is a transceiver that provides a single connection between standard Ethernet and Ethernet communication equipment.

Note: If you are connecting your ThinWire Ethernet network to a larger network, consult the *network coordinator* to make sure that you have a unique node for your system and are adhering to the network configuration rules.

Figure 2-15 shows a DEMPR on a standard Ethernet coaxial cable.

Figure 2-15: DEMPR on Standard Ethernet



MLO-1331-87

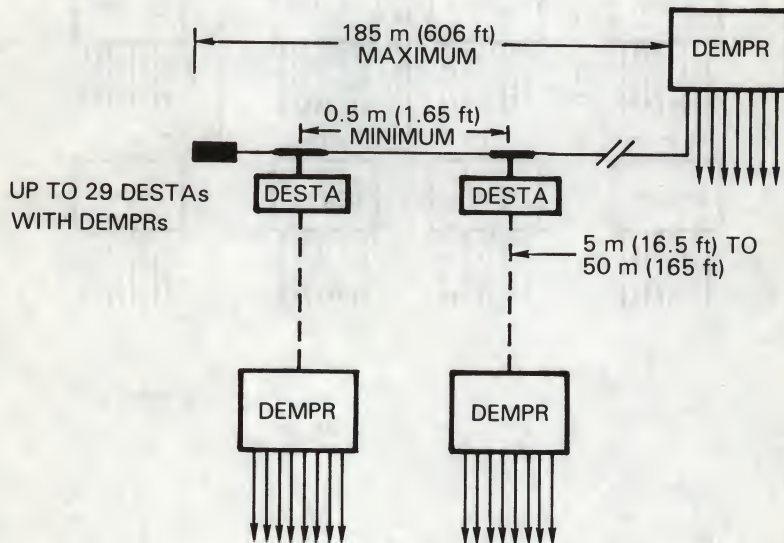
Stand-alone Cascading DEMPRs

This configuration follows the guidelines for the stand-alone DEMPR and the following guidelines:

- Cascading DEMPRs cannot be connected to a standard Ethernet LAN.
- Up to two DEMPRs are allowed between stations. Therefore, you can cascade DEMPRs on one of the ThinWire cables attached to a DEMPR. You must use a DELNI to cascade DEMPRs as shown in Figure 2-17.
- The ThinWire cable with the cascading DEMPRs can be up to 185 m (606 ft) long.
- Connect the DEMPRs to ThinWire cable, using DESTA transceivers.
- Up to 29 DESTAs (with their corresponding DEMPRs) are allowed on the ThinWire cable.
- At least 0.5 m (1.6 ft) of cable must be between DESTAs or stations.

Figure 2-16 shows stand-alone cascading DEMPRs.

Figure 2-16: Stand-alone Cascading DEMPRs



MLO-1332-87

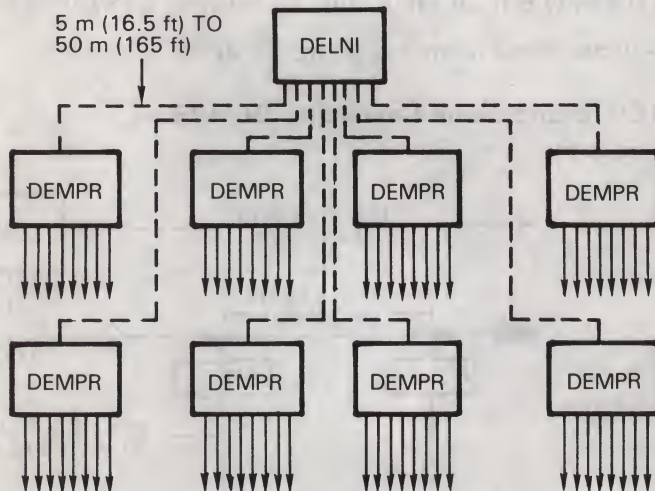
Stand-alone DELNI with DEMPRs

The guidelines for a stand-alone DELNI with DEMPRs are:

- Using the DELNI in global mode with a loopback connector attached to the ninth port, you can connect up to eight DEMPRs, using 5 to 50 m (16.5 to 165 ft) of transceiver cable for each DEMPR.
- Because only two DEMPRs are allowed between stations, you cannot have a cascading DEMPR on a DEMPR attached to a DELNI.
- Conventions for ThinWire cables connected to the DEMPRs are the same as those defined for a stand-alone DEMPR.

Figure 2-17 shows a stand-alone DELNI with DEMPRs.

Figure 2-17: Stand-alone DELNI with DEMPRs



MLO-1333-87

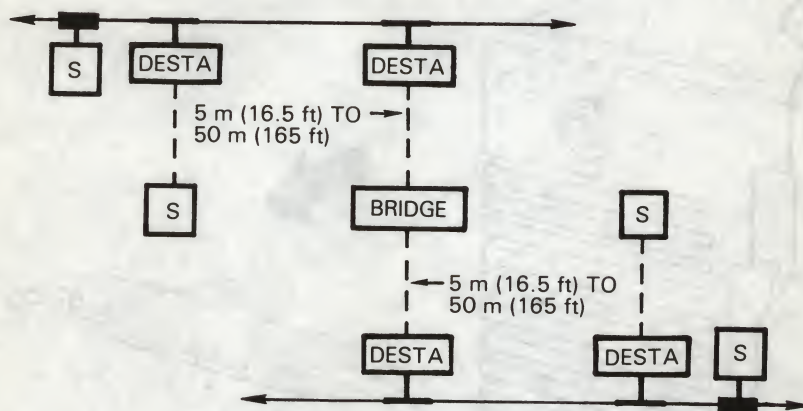
Local Bridge

Basic configuration guidelines are:

- A local bridge joins two LANs by transmitting signals over connecting transceiver cables. Each transceiver cable can be 5 to 50 m (16.5 to 165 ft) long.
- A bridge allows you to get around the 2-repeater rule. Once a message goes through a bridge, two more repeaters can be used in the next LAN to extend the network. Up to seven bridges are allowed between stations.
- A bridge acts as a LAN filter. Only messages addressed to stations on the other side of the bridge will pass through the bridge.

Figure 2-18 shows a local bridge connecting two segments of ThinWire Ethernet.

Figure 2-18: Local Bridge



MLO-1334-87

Disconnecting Stations from ThinWire Ethernet

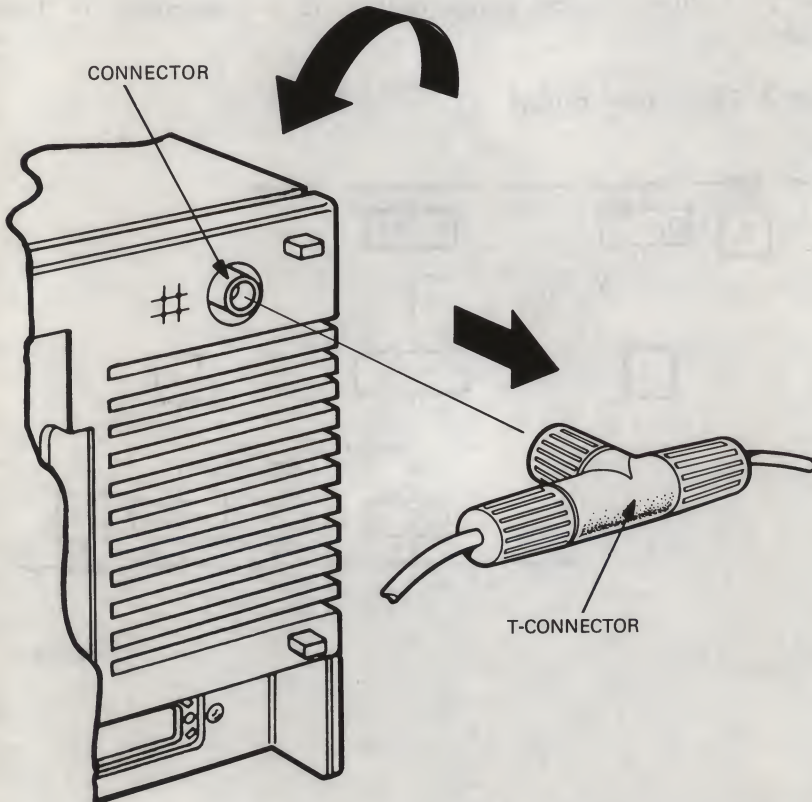
The rule for disconnecting stations from ThinWire is:

- Remove the T-connector from the station.

Caution: Do not remove the T-connector from the cable. This will break the connection on the ThinWire segment and disrupt all stations on the segment.

Figure 2-19 shows how to disconnect a station from a ThinWire segment.

Figure 2-19: Disconnecting a Station from ThinWire Ethernet



MLO-1335-87

Local Area VAXcluster Configuration

Using ThinWire Ethernet as the common interconnect, Local Area VAXcluster software extends many benefits of the VAXcluster architecture to VAXstation 2000 and MicroVAX 2000 systems.

A Local Area VAXcluster consists of one or two *boot nodes* and up to 26 *satellite nodes*.

- The boot node is both a management center for the cluster and a major resource provider. Its system disk contains the cluster common files for startup, authorization and queue setup, as well as the directory roots from which the satellite nodes are booted.

A boot node makes available to the cluster such resources as user and application data disks, printers, and distributed batch processing facilities.

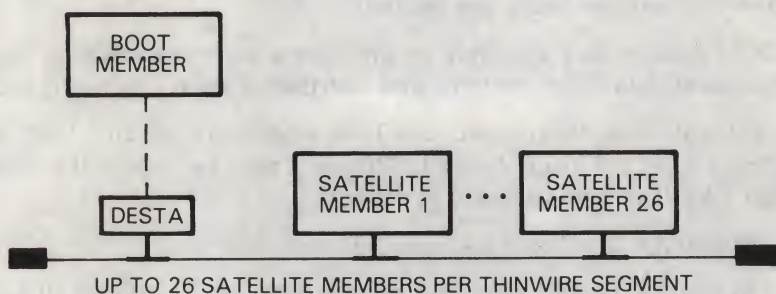
In a Local Area VAXcluster, the boot node may be any VAX system except VAX-11/725 or VAX-11/730, or it may be one of the following MicroVAX II or VAXstation II systems:

- MicroVAX II with an RA-series system disk.
- MicroVAX II with an RD54 system disk, or VAXstation II with an RD54 or any larger system disk. Note that these boot nodes support a maximum of three satellites. In addition, it is recommended that the satellites use local RD-series disks for paging and swapping.
- The satellite nodes are booted remotely from a boot node's system disk. Generally, these nodes are consumers of cluster resources, though they may also sometimes provide disk serving and batch processing resources. If satellite nodes are equipped with RD-series disks, they may, for enhanced performance, use such local disks exclusively for paging and swapping. Satellite nodes may be any of the following:
 - MicroVAX II
 - MicroVAX 2000
 - VAXstation II
 - VAXstation 2000
 - VAXstation II/GPX
 - VAXstation II/RC

Caution: All MicroVAX II and VAXstation II machines in a Local Area VAXcluster configuration must use Revision E (or later) Q-bus Network Adapter (*DEQNA*) devices and must have at least 3 Mb memory. Diskless machines require at least 4 Mb memory. Diskless machines should not be turned off.

Figure 2-20 shows a block diagram of a boot node and some of its 26 satellite nodes connected on ThinWire Ethernet.

Figure 2-20: Local Area VAXcluster



MLO-1336-87

Chapter 3

Installing ThinWire Hardware

This chapter describes how to determine your needs and how to install and troubleshoot a ThinWire Ethernet network.

Before You Start

If you are setting up a Local Area Network (LAN), you will need to designate a network coordinator to manage the network, assign unique node names and addresses for each station on the network, and provide administrative assistance to network users.

If you are connecting a ThinWire Ethernet LAN to an existing network, consult the network coordinator on the best way to connect your LAN to the larger network. Consult the network coordinator to ensure that all node names and node addresses on your LAN are unique and do not already exist in the larger network.

Determining Your Needs

This section helps you determine what ThinWire Ethernet equipment you need.

ThinWire Ethernet Cable

The maximum recommended length of cable leading from a terminator to the last station on a segment of ThinWire Ethernet is 185 m (606 ft). At least 0.5 m (1.6 ft) is required between stations.

Connectors

A ThinWire section is a single length cable. You need two connectors, one at each end, for each section of ThinWire cable.

Barrel Connectors and T-Connectors

A ThinWire segment is one or more sections of ThinWire cable interconnected by barrel or T-connectors. You need one T-connector for each DESTA, VAXstation 2000, MicroVAX 2000, or VAXmate.

DESTA and Transceiver Cable

To connect a VAXstation II, VAXstation II/GPX, MicroVAX II, Professional 300, PDP-11, VAX system, or any devices like the bridge, repeater, or server that use transceiver cables to ThinWire Ethernet, you need a DESTA and a transceiver cable.

Terminators

You need one terminator for each end of a ThinWire segment. If you connect a ThinWire segment to a DEMPR, you only need one terminator. The end connected to the DEMPR does not need a terminator.

You need a terminator for each unused connector on the DEMPR.

DEMPR

You can use a DEMPR to connect eight segments of ThinWire Ethernet in a LAN.

Estimating Your Needs

You can use the form in Table 3-1 to estimate what you need to order.

Table 3-1: Form to Order ThinWire Equipment

	Amount
Total length of ThinWire Ethernet cable	----
Connector	----
Barrel connector	----
T-connector	----
DESTA	----
Transceiver cable	----
Terminator	----
DEMPR	----

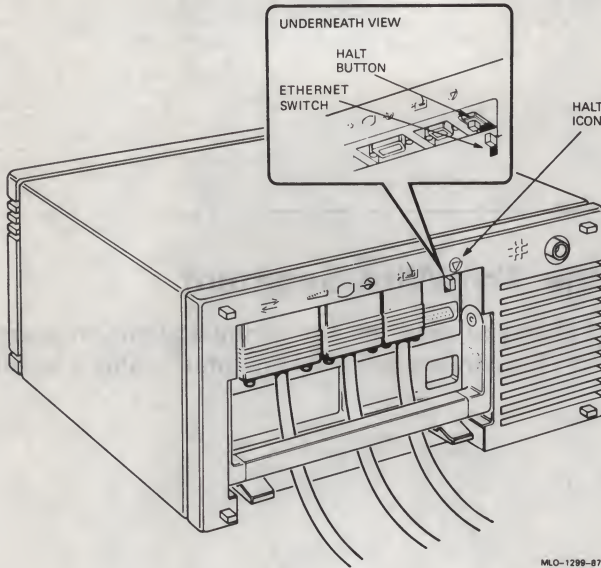
Planning the ThinWire Segment

We recommend that you plan for any future stations by connecting extra T-connectors and ThinWire segments where future stations might be needed.

Setting the Switch for ThinWire Ethernet

To use ThinWire Ethernet on a VAXstation 2000, move the Ethernet switch on the back of the system unit to the up position (Figure 3-1).

Figure 3-1: Setting the Switch for ThinWire Ethernet



Connecting to a ThinWire Ethernet Segment

The two types of stations that can connect to ThinWire Ethernet are:

1. Stations with connectors — VAXstation 2000, MicroVAX 2000, or VAXmate.
2. Stations with a transceiver cable — VAXstation II, VAXstation II/GPX, MicroVAX II, Professional 300, PDP-11, VAX-11/7xx, or VAX/8xxx.

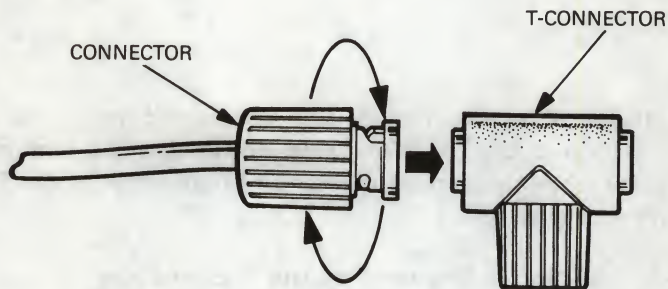
Follow the instructions for the type of station that you have.

Connecting VAXstation 2000, MicroVAX 2000, or VAXmate

To connect a VAXstation 2000, MicroVAX 2000, or VAXmate to ThinWire Ethernet:

1. Set the power switch to off (0) on the station.
2. Attach ThinWire cable to one side of the T-connector as shown in Figure 3-2.

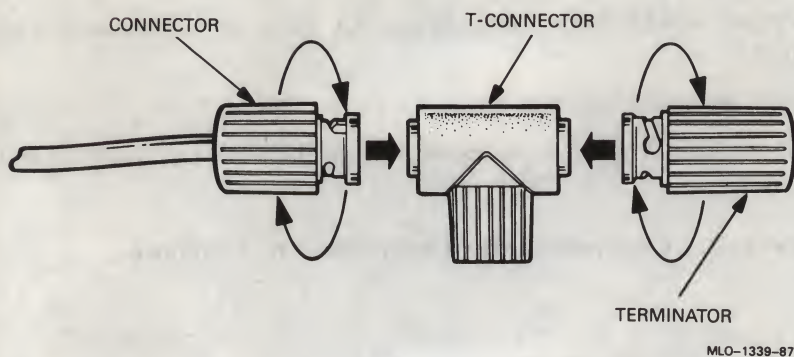
Figure 3-2: Connecting the T-connector to ThinWire



MLO-1338-87

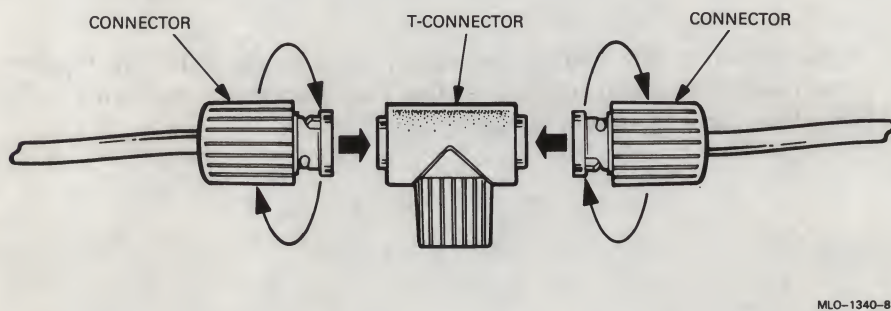
3. If the station is the first or last station in a single ThinWire segment, attach a terminator to the side of the T-connector not connected to the ThinWire cable as shown in Figure 3-3.

Figure 3-3: Connecting a Terminator to the T-connector



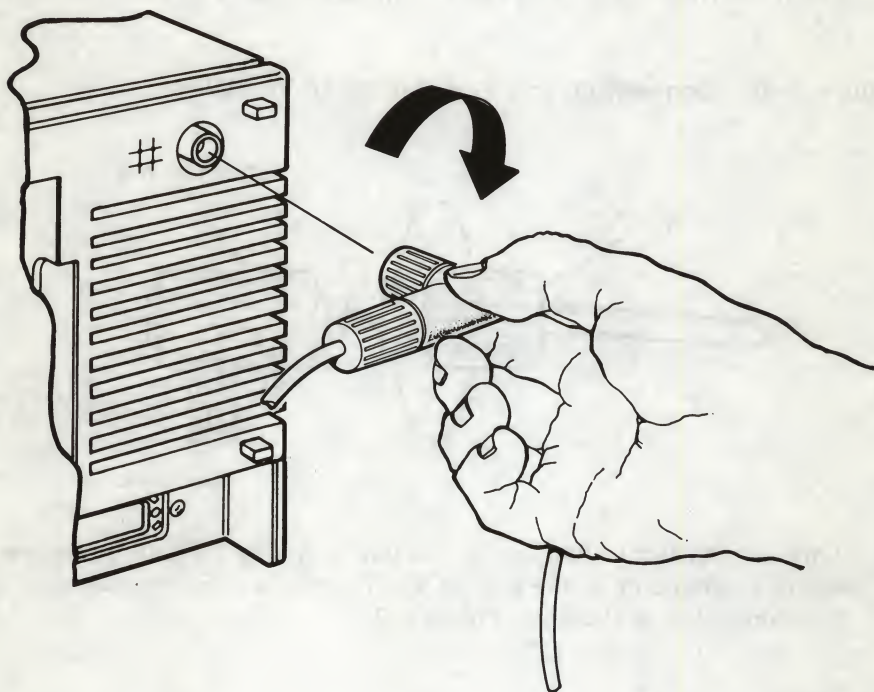
4. If the station is not the first or last station and you want to connect another station to the ThinWire cable, do not attach a terminator to the T-connector. Add another section of ThinWire cable to the T-connector as shown in Figure 3-4.

Figure 3-4: Adding a Segment to the T-connector



5. Attach the T-connector to the back of the station by pushing the T-connector into the connector and then turning it to the right as shown in Figure 3-5. This figure shows the cabling only for VAXstation 2000. If you have a MicroVAX 2000 or a VAXmate, locate the connector on the back and connect the T-connector in the same way as on the VAXstation 2000.

Figure 3-5: Connecting the T-connector to VAXstation 2000



MLO-1341-87

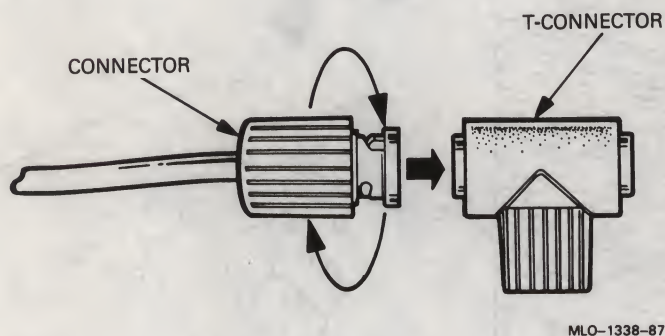
6. If you want to attach another station to the ThinWire cable, follow the directions for the type of station that you have.

Connecting a Station with a Transceiver Cable

To connect a station with a transceiver cable, such as a MicroVAX II, VAXstation II, VAXstation II/GPX, or any other VAX-11/7xx or VAX/8xxx:

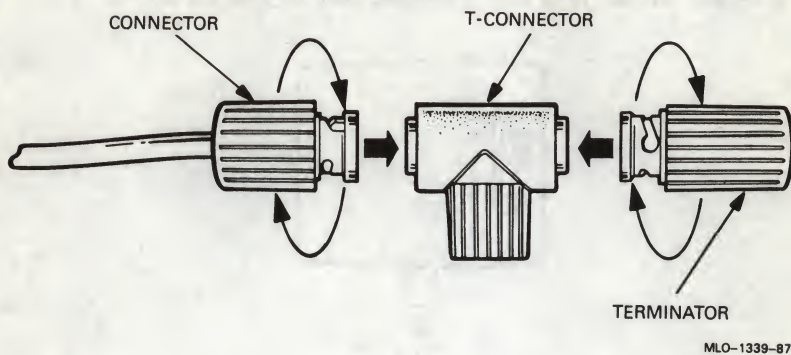
1. Set the power switch to off (0) on the station.
2. Attach ThinWire cable to one side of the T-connector as shown in Figure 3-6.

Figure 3-6: Connecting the T-connector to ThinWire



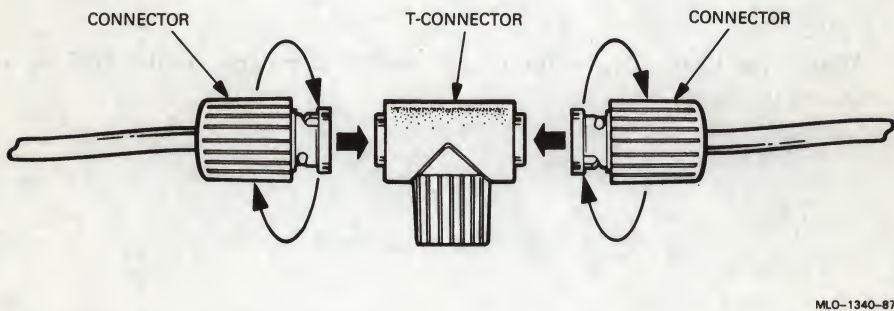
3. If the station is the first or last station in a single ThinWire segment, attach a terminator to the side of the T-connector not connected to the ThinWire cable as shown in Figure 3-7.

Figure 3-7: Connecting a Terminator to the T-connector



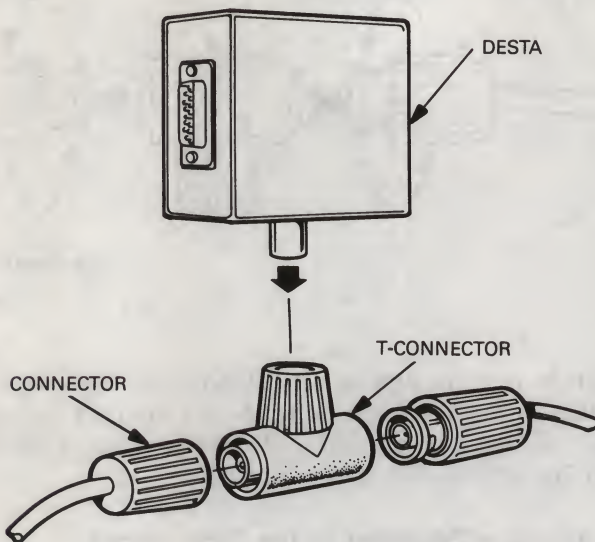
4. If the station is not the first or last station and you want to connect another station to the ThinWire cable, do not attach a terminator to the T-connector. Add another section of ThinWire cable to the T-connector as shown in Figure 3-8.

Figure 3-8: Adding a Segment to the T-connector



5. Attach the T-connector to the DESTA's connector as shown in Figure 3-9.

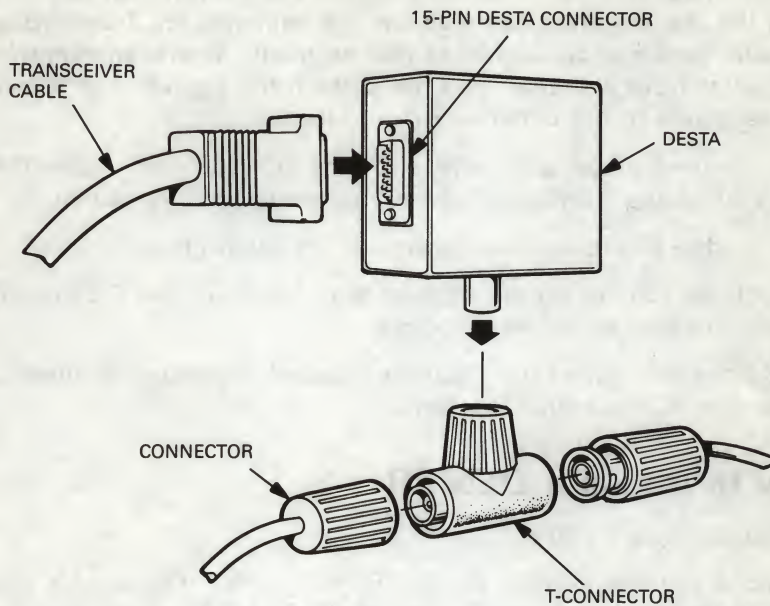
Figure 3-9: Attaching the T-connector to the DESTA



MLO-1345-87

6. Attach the 15-pin connector on the transceiver cable to the DESTA as shown in Figure 3-10.

Figure 3-10: Attaching the Transceiver Cable to the DESTA



MLO-1346-87

7. Attach the transceiver cable to the back of the station.
8. If you want to attach another station to ThinWire, follow the directions for the type of station that you have.

Connecting to an Existing ThinWire Network

Caution: When you plan ThinWire segments, be aware that disconnecting one of the stations from the segment (by removing its T-connector from the cable) causes a disruption of that segment. However, removing the T-connector from a station does not disturb the segment. In either case, other segments in the network are not affected.

If you planned ahead and have a T-connector for every place that you anticipated adding a station, plug the T-connector into the station.

If you need to add more T-connectors, do the following:

1. Notify all stations on the segment that the network will be down for a period of time to add new stations.
2. Add new stations to the ThinWire segment, following the directions for the type of station that you have.

How to Install a DEMPR

Before installing a DEMPR:

1. Find a suitable location for the DEMPR unit. You need a clearance of 10.16 cm (4 in.) on all sides of the DEMPR unit to ensure proper ventilation.
2. Be sure the AC power outlet is within 1.83 m (6 ft) of the installation location.

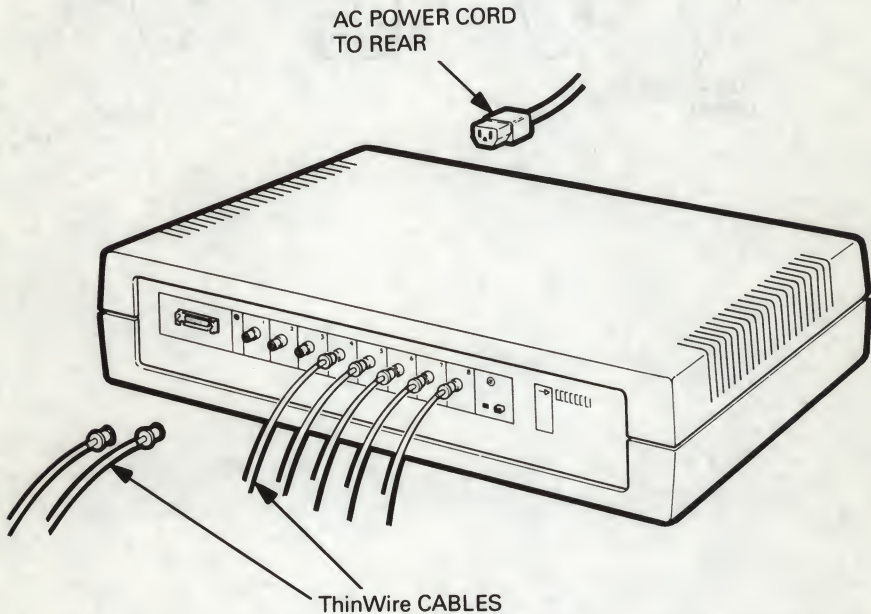
Refer to the *DIGITAL Ethernet ThinWire Multiport Repeater (DEMPR) Installation and User's Guide* to verify installation of the DEMPR and to do a self-test before connecting the DEMPR to an active network.

Stand-alone DEMPR

To set up a stand-alone DEMPR:

1. Set the power switch to off (0) on all stations.
2. Connect each station to a ThinWire Ethernet segment as described in Connecting a Station to a ThinWire Ethernet Segment section.
3. Connect each ThinWire Ethernet segment to a connector on the DEMPR. Figure 3-11 shows ThinWire cables connected to the DEMPR.

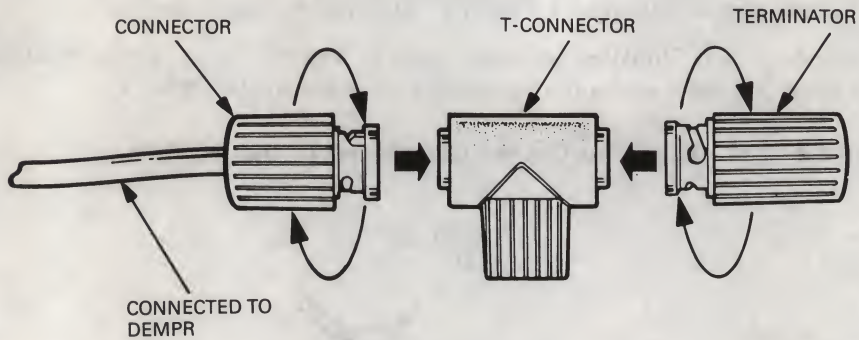
Figure 3-11: ThinWire Cables Connected to the DEMPR



MLO-1347-87

4. Attach a terminator to the end of each ThinWire segment connected to the DEMPR as shown in Figure 3-12.

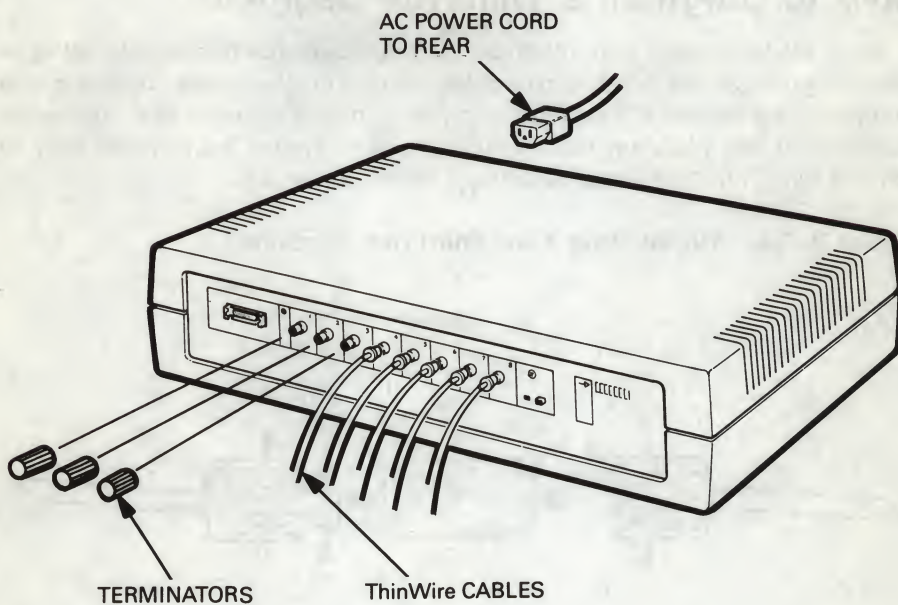
Figure 3-12: Attaching a Terminator to a ThinWire Segment



MLO-1348-87

5. Attach a terminator to any unused port on the DEMPR as shown in Figure 3-13.

Figure 3-13: Terminator Connected to the DEMPR



MLO-1349-87

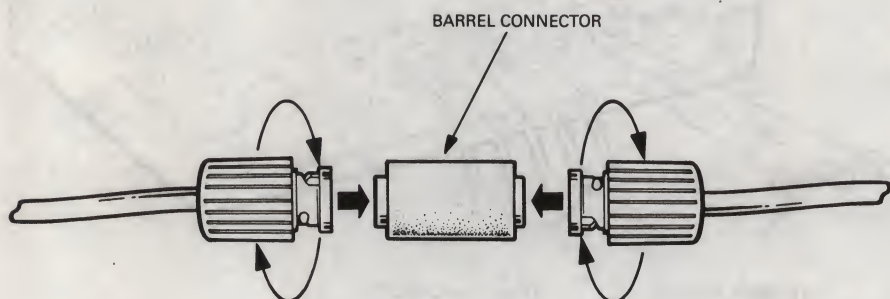
Connecting the DEMPR to Standard Ethernet

Consult your network coordinator to connect the DEMPR to an existing Ethernet network.

How to Lengthen a ThinWire Segment

If you want to connect two ThinWire sections to lengthen the cable between stations, you can use a barrel connector. However, the barrel connector will count as a station on a ThinWire segment and will decrease the number of stations you can place on the segment by one. Figure 3-14 shows how to connect two ThinWire sections, using a barrel connector.

Figure 3-14: Connecting Two ThinWire Sections



MLO-1350-87

How to Verify Network Installation for a VAXstation 2000 or MicroVAX 2000

1. After you have connected your station to ThinWire Ethernet, turn on your VAXstation 2000, or MicroVAX 2000. You will see the following:

F...E...D...C...B...A...9...8...7...6...5...4...3...2...1

2. Then the prompt >>> will appear. Type the **TEST 50** command at the prompt.

>>>TEST 50

The Ethernet hardware address and information about each module appear on the terminal screen.

The Ethernet hardware address has the following format:

ID XX-XX-XX-XX-XX-XX

and could look like this, for example:

ID 08-00-2B-02-CC-71

3. Write down your Ethernet hardware address and save it. Each Ethernet hardware address is unique. You or your network coordinator will need a unique Ethernet hardware address for each system when configuring DECnet software.
4. If the last line of information appearing above the >>> prompt is:

NI 0000.0001

the Ethernet Module is installed and has been successfully tested.

If NI 0000.0002 or any number below .7000 appears on this line, there is a failure in the Ethernet module. Call a service representative.

If NI 0000.7000 or any number above .7000 appears on this line, then check all ThinWire Ethernet connections, using the checklist in the section on Troubleshooting the ThinWire segment.

5. After you have checked all ThinWire Ethernet connections, to retest the Ethernet Module, type the following command at the prompt:

>>>TEST 1

6. If a connection has been established, the >>> prompt will appear.

7. If a connection is not established, a number and the word **FAIL** will appear.
8. Retry the **TEST 50** command and check the last line of information above the prompt. It should be:

NI 0000.0001

How to Verify Installation for a VAXmate

Consult the *VAXmate System Administrator's Guide* for information on verifying the installation of your VAXmate on ThinWire Ethernet.

Troubleshooting the ThinWire Segment

If you have verified the ThinWire Ethernet installation and have found problems, use this checklist to make sure that all connections are correct:

1. Check that all connections are secure on the ThinWire Ethernet segment.
2. Do not connect the connector on the ThinWire cable to the connector on the station or on the DESTA. You must use a T-connector between the connector on the cable and the station or DESTA.
3. Do not connect any ThinWire segment between a ThinWire station and a T-connector. (The center of a T-connector must attach directly to a connector on the station.)
4. Do not connect any branches off a ThinWire segment except through a DEMPR. (You cannot branch off another segment of ThinWire cable from any segment unless you use a DEMPR.)
5. Do not loop a ThinWire segment from one port on the DEMPR to another port on the DEMPR.
6. Do not disconnect a T-connector from an operating ThinWire Ethernet segment to remove a station. Simply disconnect the T-connector from the station.
7. Do not disconnect a terminator from an operating network. This procedure will disrupt network operation.

Troubleshooting the DEMPR

Refer to the *DIGITAL Ethernet ThinWire Multiport Repeater (DEMPR) Installation and User's Guide* to verify installation of the DEMPR and to do a self-test before connecting the DEMPR to an active network.

Troubleshooting the DESTA

Check the following list to be sure that the DESTA is functioning properly:

1. Check that the LED on the side of the box is lit. The LED indicates that the DESTA has power.
2. If the LED is not lit and the DESTA is connected to a controller that is powered up, then your DESTA may need to be replaced.
3. If the LED is on but the unit is still suspect, try running an external self-test on the QNA or UNA controller.
4. If you cannot pinpoint the problem, call your field service representative.

Troubleshooting Network Software

If you have verified the ThinWire installation and are not able to perform any network functions such as copying files from one system to another, check that you have installed the correct communications software. Consult the documentation for the network software that you have installed.

Introduction

The purpose of this report is to provide a comprehensive overview of the current state of the field and to identify key areas for future research. The report is organized into several sections, each focusing on a different aspect of the topic.

Background and Context

The field has seen significant progress in recent years, with new discoveries and developments in various sub-fields. This section provides a historical perspective on the field and discusses the challenges that have shaped its development.

The current state of the field is characterized by a high degree of specialization and a focus on interdisciplinary research. This section discusses the latest findings and trends in the field, as well as the challenges that remain to be addressed.

Methodology and Data Collection

The data for this report was collected through a combination of literature review, interviews with experts in the field, and analysis of existing datasets. The methodology used in this report is designed to ensure the accuracy and reliability of the findings.

Appendix A

Associated Documents

Product availability and order numbers may vary with area. Please contact your local DIGITAL representative for ordering information.

VAXstation 2000 Hardware Installation Guide (EK-VAXAA-IN)

VAXstation 2000 Owner's Manual (EK-VAXAA-OM)

MicroVAX 2000 Hardware Installation Guide (EK-MVXAA-IG)

MicroVAX 2000 Owner's Manual (EK-MVXAA-OM)

VAXstation 2000/MicroVAX 2000 Maintenance Guide (EK-VSTAA-MG)

VAXstation 2000/MicroVAX 2000 Technical Manual (EK-VTTAA-TM)

DECconnect System General Description (EK-DECSY-GD)

DECconnect System Requirements Evaluation Workbook (EK-DECSY-EG)

DECconnect System Installation and Verification Guide (EK-DECSY-VG)

DECconnect System Planning and Configuration Guide (EK-DECSY-CG)

DIGITAL ThinWire Ethernet Station Adapter (DESTA) Installation Card (EK-DESTA-IN)

DIGITAL ThinWire Ethernet Station Adapter (DESTA) Technical Manual (EK-DESTA-TM)

DIGITAL Ethernet ThinWire Multiport Repeater (DEMPR) Installation and User's Guide (EK-DEMPR-UG)

DIGITAL Ethernet ThinWire Multiport Repeater (DEMPR) Technical Manual (EK-DEMPR-TM)

Unshielded Twisted-Pair Ethernet Adapter Installation Guide (EK-TPEIG-IN)

Unshielded Twisted-Pair Ethernet Wiring Installation and Characterization Guide (EK-TPEWC-IN)

Unshielded Twisted-Pair Ethernet Wiring Closet/SER Adapter Installation Instructions (EK-TPECA-IN)

Unshielded Twisted-Pair Ethernet Office Adapter Installation Instructions (EK-TPEOA-IN)

Glossary

barrel connector

A female connector for connecting two sections of ThinWire cable.

boot node

The management center for the cluster and its major resource provider.

bridge

An active network device used to join two Ethernet segments to create an extended LAN. The bridge is a specialized store-and-forward and packet-filtering station that synchronizes traffic between LANs and isolates local traffic.

coaxial cable

A 2-conductor, concentric, constant impedance transmission cable.

DEBET

See bridge.

DECconnect

DIGITAL's simple, cost-effective cabling system for extending Ethernet and terminal interconnections into offices and work areas.

DECnet

DIGITAL networking software that runs on nodes in both local and wide-area networks.

DELNI

A local network interconnect product that provides eight separate network interfaces from a single transceiver tap.

DEMPR

A multiport repeater that provides eight ThinWire Ethernet drops from a single standard Ethernet connection.

DEQNA

The abbreviation for DIGITAL Equipment Q-bus Network Adapter. DEQNA connects MicroVAX and Q-bus-based PDP-11 systems to the Ethernet.

DESTA

A station adapter that acts as a ThinWire Ethernet transceiver. A DESTA allows you to connect a station with a transceiver cable to ThinWire Ethernet.

DEUNA

The abbreviation for DIGITAL Equipment UNIBUS Network Adapter. DEUNA connects VAX and UNIBUS-based PDP-11 systems to the Ethernet.

connector

A BNC-style connector that connects a section of ThinWire cable to a T-connector, to a system, or to a barrel connector.

Ethernet

A type of local area network based on Carrier Sense Multiple Access with Collision Detection (CSMA/CD).

ground

A voltage reference point in a system that has a zero voltage potential.

H4000-BA

Ethernet transceivers. *See* transceiver.

local area network (LAN)

A privately owned communication network whose speed is upward of 1 megabits-per-second.

Local Area VAXcluster

Extends the current VAXcluster architecture to include MicroVAX 2000 and VAXstation 2000 in a VAXcluster environment. Local Area VAXclusters use ThinWire or standard Ethernet as the common interconnect.

multiport repeater

A repeater used to connect two or more cable segments.

multisegment LAN

A LAN composed of more than one cable segment.

network coordinator

The network coordinator manages the network, assigns unique node names and addresses for each station on the network, and provides administrative assistance to network users.

ohm

A unit of measurement, the unit of electrical resistance through which a potential difference of one volt will maintain a current of one ampere.

plenum

A compartment or chamber to which one or more compartments are connected in a building ventilation system, only for carrying environmental air.

polyvinyl chloride (PVC)

The standard coating used on cables. PVC is not UL-certified for installation in environmental airspace.

port

A socket or connector at the back of the computer to which a terminal, printer, or other communication devices are connected.

PVC

The standard coating used on cables. PVC is not UL-certified for installation in environmental airspace.

repeater

The interconnecting link between two Ethernet cable segments. The repeater provides a means of extending Ethernet networks beyond the limits imposed by a single segment. Repeaters perform the basic actions of restoring signal amplitude, waveform, and timing amplitude to normal data and collision signals.

satellite equipment room (SER)

A room or wiring closet used as the central wiring hub for up to 64 drops.

satellite node

A node that is booted remotely from the system disk on the boot node.

section

A single length of ThinWire Ethernet cable terminated at each end with a connector.

segment

A length of cable made up of one or more cable sections connected with barrel connectors or T-connectors.

SER

See satellite equipment room.

single-segment LAN

A LAN that is composed of only one coaxial cable segment.

standard Ethernet

An IEEE standard 802.3 compliant Ethernet network composed of standard Ethernet cable as opposed to ThinWire Ethernet cable.

station

A single addressable device on a LAN, such as a VAXstation 2000, MicroVAX 2000, or any VAX.

station adapter

An active device used to connect stations that have transceiver connectors to ThinWire Ethernet cable. The DESTA is a station adapter.

T-connector

Connectors used to join ThinWire Ethernet cable sections. The connectors also attach to a station.

TCP/IP

Networking protocols that are standard with the ULTRIX-32 and ULTRIX-32W software.

teflon cable

A special coating for cable that is UL-certified for installation in environmental airspace.

terminator

A special connector used on one or both ends of an Ethernet segment that provides the 50-ohm termination resistance needed for the cable.

ThinWire

A DIGITAL trademark used to describe its 10base2 (IEEE standard 802.3 compliant) Ethernet products used for local distribution of data.

topology

The physical arrangement and relationship of interconnected nodes and lines in a network.

transceiver

A device that provides a single physical connection between standard Ethernet and Ethernet communication equipment.

unshielded twisted-pair cable

Multiple-conductor cable whose component cables are paired together, twisted, and enclosed within a single jacket.

ULTRIX-32, ULTRIX-32W

DIGITAL implementations of native mode UNIX software.

802.3

An IEEE standard describing the physical and data link layers of a local area network based on bus topology and Carrier Sense Multiple Access/Collision Detect (CSMA/CD).

1. The first part of the report deals with the general situation of the country and the position of the various groups.

2. The second part of the report deals with the economic situation and the position of the various groups.

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Index

A

Air plenum
definition, 2-3

B

Barrel connector
connecting, 3-16
description of, 2-5
determining need for, 3-2

Boot node
definition, 2-23
requirements, 2-23

C

Central equipment room, 2-10
Combined standard/ThinWire
Ethernet LAN configuration,
2-18
Configuration
combined standard/ThinWire
Ethernet LAN, 2-18
Local Area VAXcluster, 2-23
local bridge, 2-21
multisegment ThinWire, 2-13
single segment, 2-11
stand-alone cascading DEMPRs,
2-19
stand-alone DELNI with DEMPRs,
2-20
stand-alone DEMPR, 2-17
Configuration symbols, 2-14
Connector
determining need for, 3-1
Connectors
list of, 2-5

D

Daisy-chain approach
benefits of, 2-10
DEBET
See Ethernet bridge
DECconnect and daisy-chain
benefits of, 2-10
DECnet
down-line loading, 1-3
file transfer, 1-3
network management, 1-3
network virtual terminal, 1-3
remote command file submission
and execution, 1-3
remote file access, 1-3
software, 1-3
task-to-task communications, 1-3
DECnet-ULTRIX, 1-3
DELNI, 2-18
DEMPR
See DIGITAL ThinWire Ethernet
Multiport Repeater
connecting to standard Ethernet,
3-16
installing, 3-12
DEQNA, 1-4
DESTA
See DIGITAL ThinWire Ethernet
Station Adapter
determining need for, 3-2
DEUNA, 1-4
DIGITAL Network Architecture, 1-3
DIGITAL ThinWire Ethernet Multiple
Repeater
attaching to Ethernet, 2-18

DIGITAL ThinWire Ethernet Multiport

Repeater, 2-5, 2-6

definition of, 2-6

features of, 2-6

DIGITAL ThinWire Ethernet Station

Adapter, 2-6

definition, 2-7

features of, 2-7

ports of, 2-7

Diskless workstations, 2-24

DNA

See DIGITAL Network Architecture

E

Ethernet

standard, 1-1

switch, 2-1

Ethernet bridge, 2-6

definition, 2-8

Ethernet hardware address, 3-17

Ethernet Module, 2-2

Ethernet repeater

definition, 2-15

DEMPR, 2-15

Ethernet transceiver

H4000-BA, 2-18

H

H4000, 2-11

H4000-BA, 2-18

definition, 2-18

I

IEEE standard

ThinWire Ethernet, 2-3

International Standards Organization, 1-3

ISO

See International Standards
Organization

L

LAN

See Local Area Network

Local Area Network

definition, 1-2

DEMPRs and, 2-6

extended, 2-8

Local Area VAXcluster

remote booting, 1-4

Local Area VAXcluster Configuration, 2-23

Local Area VAXclusters, 1-4

software installation and, 1-4

system management tasks, 1-4

Local bridge configuration, 2-21

M

MicroVAX 2000

connecting to ThinWire, 3-5

verifying network installation for,
3-17

Multisegment ThinWire Configura- tion, 2-13

N

Network

definition, 1-1

features, 1-1

hardware, 1-1

software, 1-1

verifying installation, 3-17

Network coordinator, 2-18

Network traffic control

DEBETs and, 2-8

Node address, 3-1

Node name, 3-1

P

Planning stations, 3-3

Polyvinyl chloride, 2-3

PVC

See polyvinyl chloride

R

- 2-repeater rule
 - definition, 2-15

S

- Satellite node
 - definition, 2-23
 - requirements, 2-23
- Section
 - definition, 2-3
- Segment
 - definition, 2-3
 - lengthening a, 3-16
- Single segment configuration, 2-11
- Stand-alone cascading DEMPRs
 - configuration, 2-19
- Stand-alone DELNI
 - with DEMPR configuration, 2-20
- Stand-alone DEMPR configuration,
 - 2-17
- Station
 - connecting to existing ThinWire
 - network, 3-12
 - connecting with transceiver cable,
 - 3-8
 - definition, 2-3
- Stations
 - adding new, 3-3
 - connecting to ThinWire, 3-4
 - types of, 3-4
- Symbols
 - configuration, 2-14
- System Management
 - Local Area VAXclusters and, 1-4

T

- T-connector
 - description of, 2-5
 - determining need for, 3-2
- Teflon, 2-3
- Terminator
 - description of, 2-5
 - determining need for, 3-2

- Terminators
 - list of, 2-5
- ThinWire Ethernet
 - connectors, 2-5
 - cutting and crimping, 2-3
 - definition, 1-1
 - disconnecting from, 2-14, 2-22
 - IEEE standard, 2-3
 - ordering information, 2-4
 - rules, 2-14
 - spool of, 2-3
 - terminators, 2-5
 - uses of, 1-2
- Transceiver
 - definition, 2-7
- Transceiver cable, 3-2
- Troubleshooting
 - DESTA, 3-19
 - network software, 3-19
 - ThinWire segment, 3-18

U

- U.L.
 - See Underwriter's Laboratory
- ULTRIX
 - networking protocol, 1-3
 - TCP/IP, 1-3
- ULTRIX-32, 1-3
- Underwriter's Laboratory, 2-3
- Unshielded twisted pair, 1-2

V

- VAXmate
 - connecting to ThinWire, 3-5
 - verifying network installation for,
 - 3-18
- VAXstation 2000
 - connecting to ThinWire, 3-5
 - verifying network installation for,
 - 3-17

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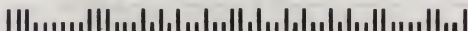
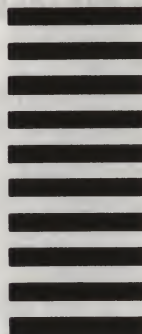
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